STATE OF MICHIGAN

JOHN ENGLER, Governor

DEPARTMENT OF NATURAL RESOURCES

Stevens T. Mason Building, P.O. Box 30028, Lansing, MI 48909

ROLAND HARMES, Director

AH. #1

H1

August 10, 1993

Mr. Rauland Sharp (HSRW-6J)
Remedial Project Manager
U.S. EPA, Region 5
77 West Jackson Blvd.
Chicago, IL 60604

Dear Mr. Sharp:

Subject: Michigan Department of Natural Resources Recommendations for Additional Remedial Investigation Field Work at the Albion-Sheridan Township Landfill Superfund Site, Calhoun County, Michigan.

During our teleconference on Thursday August 5, 1993, the Michigan Department of Natural Resources (MDNR) agreed to supply the U.S. Environmental Protection Agency (EPA) with our recommendations for additional field work that we deemed necessary to further define the contaminant plume emanating from the landfill. The MDNR expressed its concerns that there could be a serious threat to the quality of the Marshall Sandstone bedrock aquifer which serves as a regional water supply for private and public water supplies.

Listed below are our recommendations for some additional field work that is necessary for us to be able to evaluate the nature, extent and fate of the contaminants identified by the work the EPA has recently completed.

Recommendations

1. A map should be provided that shows other major (municipal, industrial, agricultural) pumping wells near the site and between the site and city. Information should be provided on their pumping rates.

   Additionally, a regional map of static water levels in the bedrock aquifer should be made. This will help us understand the possible interactions of the site with this aquifer. Also the potential effects of the major wells on the aquifer under the site can better be evaluated.

2. Larger cross sections using other well logs in the area should be made to help define the geology of the site.

3. A bed rock topography map, a weathered bedrock topography map, an aquifer thickness map of the glacial aquifer and a weathered bedrock aquifer thickness map would provide for easier analysis of the aquifer and contaminate transport.

4. Has a calculation been made of how much water the river gains in the vicinity of the landfill? If not, this might be helpful information to determine how much water is discharging from the aquifer to the river. If there is sufficient data, various reaches of the river could be analyzed to determine discharge points from the aquifer.

5. One of the difficulties with the data that we have is that, it is difficult to determine where groundwater is coming from and how the different "aquifers" (glacial, weathered bedrock, bedrock) are interacting. Also, the interpretation of how the contamination is getting into the lower aquifer is not clearly defined. It would be helpful to prepare Stiff/Piper diagrams and to do geochemical analysis of the aquifers. This would mean sampling for carbonate, bicarbonate, sodium, calcium, magnesium, iron, sulfate and chloride during another round of sampling. Ion-cation balances should also be done.

6. We recommend that total dissolved solids maps and cross sections be drawn.

7. We recommend that the location of the abandoned septic field be placed upon a map.

Well Locations and Justification

The following comments relate to the map of proposed well nest locations that I have attached to this memo. Generally these locations have been chosen in order to address specific concerns. However, overall we believe that a more complete picture of the site geology, site hydrogeology and contaminate distribution is needed. The present data is insufficient to provide a more complete picture of the site.

Each of these wells should be vertically sampled for VOCs and field parameters. As a minimum, we recommend a nest of three wells at each location; one for each of the distinct hydrogeologic environments. Also, only four (4) well nests are recommended at this time. However, should contamination be found in any of the wells, the need for additional wells will need to be evaluated.

Although we are not making any specific recommendations at this time, we would like to discuss the utility of trying to determine the relationship of the landfill contamination and its connection to the groundwater contamination. (i.e. is there a particular area that is contributing the majority of the contaminates to the aquifer?)

Well Nest #1

Well nest #1 is located between the river and the plume to help determine to what extent the bedrock aquifer is discharging to the river.

Well nest #2 is located downgradient of MW9 in order to determine the end of the plume in this direction and to provide more information on the vinyl chloride contamination.

Well nest #3 is located approximately downgradient of MW* in order to determine the extent of the plume in this direction, to provide more information on the vinyl chloride contamination in this direction and to provide more hydrogeologic information on the mounded or perched aquifer in this area. Additionally, it will help better define the hydrogeologic characteristics of the weathered bedrock and bedrock aquifers in this area. We are uncertain of how far the influence of the major pumping wells extends toward the site.

Well nest #4 is located on the other side of, or near the center of, a potential groundwater divide. We feel it is important to insure that no undetected contamination is moving toward the Orchard Noll area. Additionally, a nest of wells in this area would provide data that would help fill a major gap in our understanding on the groundwater flow away from the site.

As stated previously, these are somewhat tentative recommendations. The site hydrogeology is complicated by a variety of factors and to date the chemical data is contradictory. We feel it would be very beneficial to meet with EPA and WW to discuss further actions at the site in regards to the groundwater investigation and are willing to do so at your earliest convenience.

If you have any questions and/or you would like to set up a meeting, feel free to contact me.

Sincerely,

Gene L. Hall

Gene L. Hall
Superfund Section
Environmental Response Division
517-373-6808

cc: Ms. Claudia Kerbawy, MDNR
Mr. James Heinzman, MDNR
Mr. Robert Delaney, MDNR
Albion-Sheridan Township file (H-1)

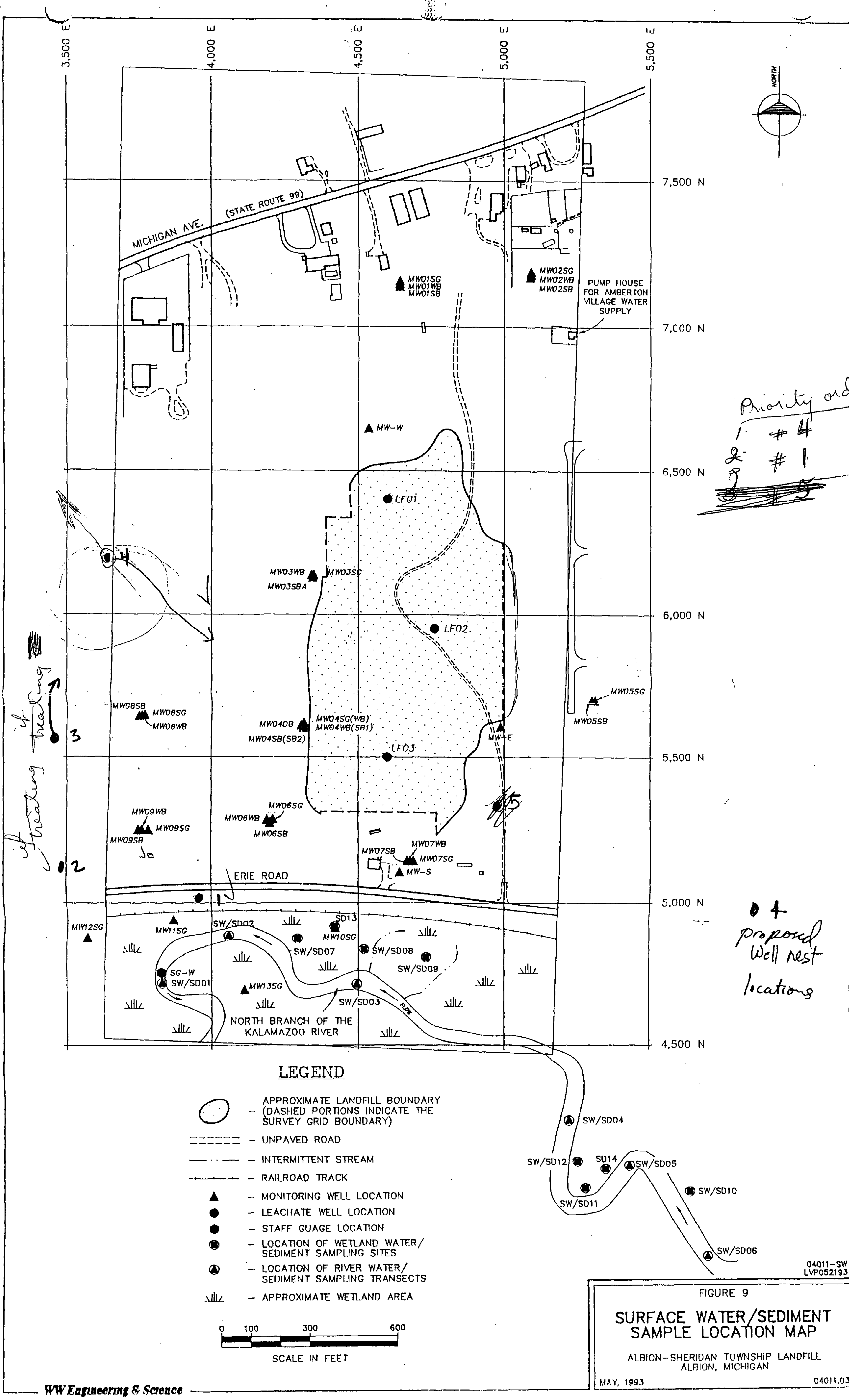

3,500 E
4,000 E
4,500 E
5,000 E
5,500 E
7,500 N
7,000 N
6,500 N
6,000 N
5,500 N
5,000 N
4,500 N
NORTH
MICHIGAN AVE.
(STATE ROUTE 99)
MW01SG
MW01WB
MW01SB
MW02SG
MW02WB
MW02SB
PUMP HOUSE FOR AMBERTON VILLAGE WATER SUPPLY
MW-W
LF01
LF02
LF03
MW03WB
MW03SG
MW03SBA
MW04DB
MW04SG(WB)
MW04WB(SB1)
MW04SB(SB2)
MW05SG
MW05SB
MW-E
MW08SB
MW08SG
MW08WB
MW09WB
MW09SG
MW09SB
MW06SG
MW06WB
MW06SB
MW07SB
MW07WB
MW07SG
MW-S
ERIE ROAD
MW12SG
MW11SG
SW/SD02
SD13
MW10SG
SW/SD07
SW/SD08
SW/SD09
SG-W
SW/SD01
MW13SG
SW/SD03
FLOW
NORTH BRANCH OF THE KALAMAZOO RIVER
SW/SD04
SW/SD12
SD14
SW/SD05
SW/SD11
SW/SD10
SW/SD06
Priority order
1. #4
2. #1
3. #5
if treating
● 4 proposed Well nest locations
LEGEND
– APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
– UNPAVED ROAD
– INTERMITTENT STREAM
– RAILROAD TRACK
– MONITORING WELL LOCATION
– LEACHATE WELL LOCATION
– STAFF GUAGE LOCATION
– LOCATION OF WETLAND WATER/ SEDIMENT SAMPLING SITES
– LOCATION OF RIVER WATER/ SEDIMENT SAMPLING TRANSECTS
– APPROXIMATE WETLAND AREA
0 100 300 600
SCALE IN FEET
04011-SW
LVP052193
WW Engineering & Science

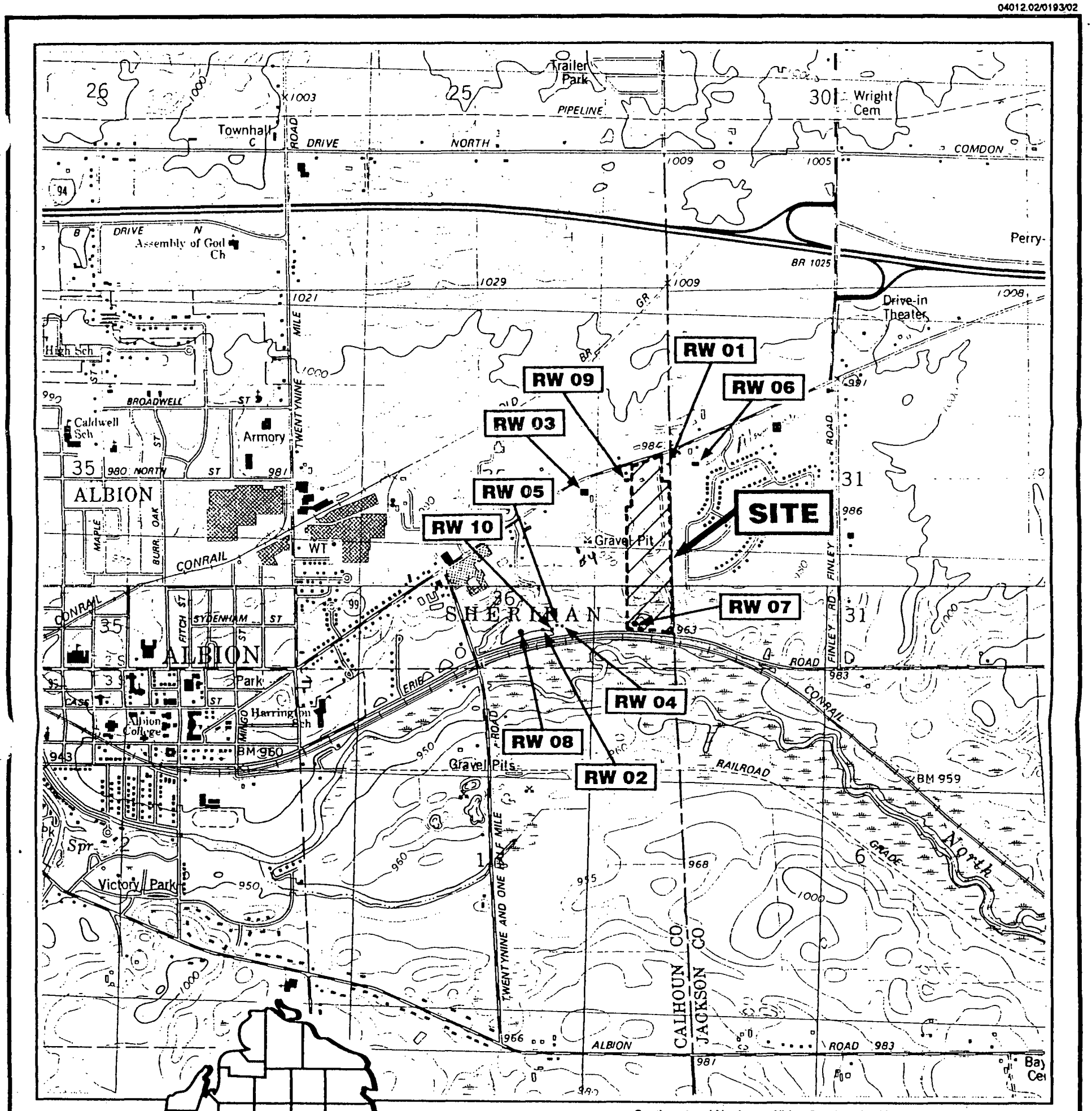
FIGURE 9

SURFACE WATER/SEDIMENT SAMPLE LOCATION MAP

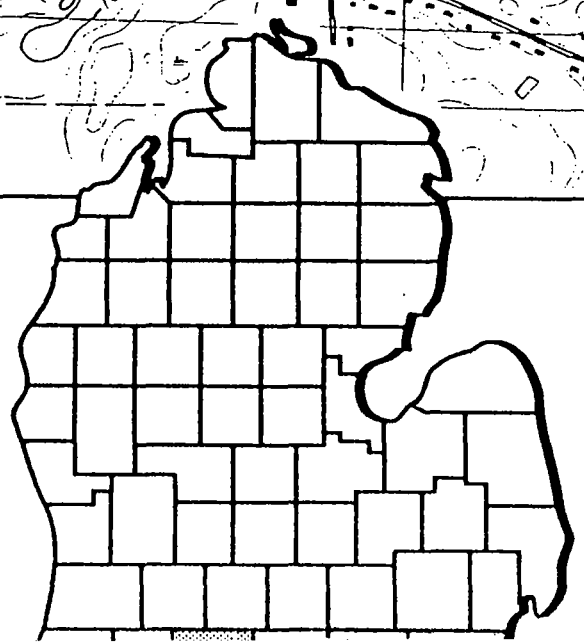
ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

MAY, 1993 04011.03

04012.02/0193/02



Southeast and Northeast Albion Quadrangles U.S.G.S. 7.5 minute series, 1981



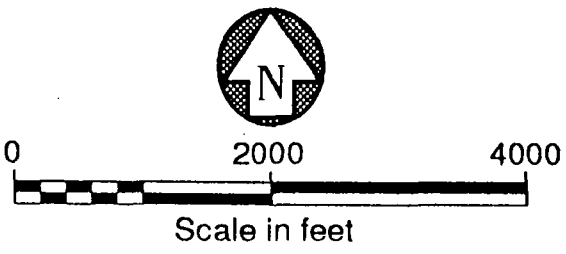


FIGURE 10

Attachment #2

B NORTH — B' SOUTH

AREA OF LANDFILL

MW01 — LF01 (13,424) — MW03 — MW04 — MW06 — ERIE ROAD — AMTRAK RAILROAD — MW11SG — NORTH BRANCH OF THE KALAMAZOO RIVER — MW13SG

ELEVATION IN FEET

SG (795)
WB (777)
SB (909)

SG (1546)
WB (1134)
SBA (1002)

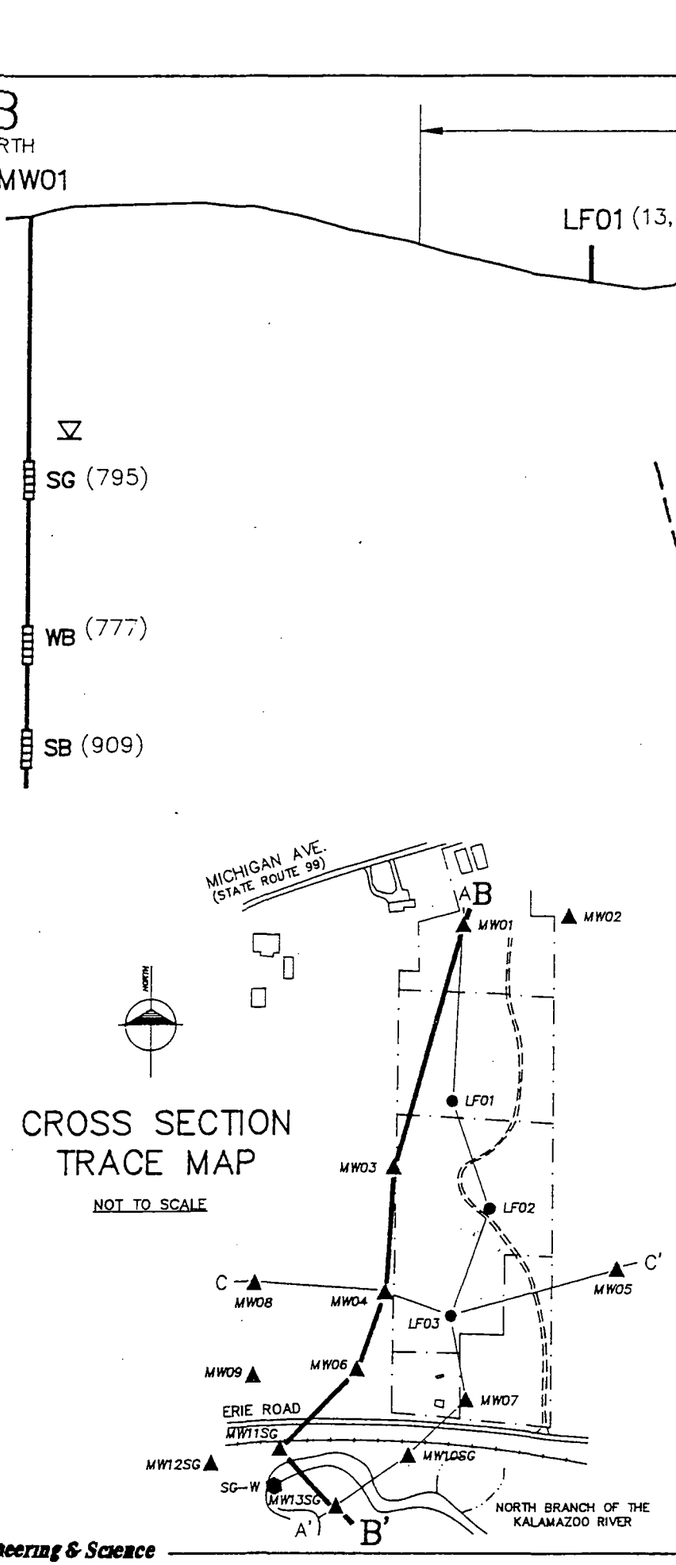
SG(WB) (539)
WB(SB1) (1145)
SB(SB2) (1669)

SG(413)
WB (1119)
SB (1263)

DB (658)

(412)
(547)

1500 1300 1200 1100 1000 1400 1600



CROSS SECTION TRACE MAP

NOT TO SCALE

LEGEND

—1000— – SPECIFIC CONDUCTANCE CONTOUR ROUND 2 – (umhos/cm)

(658) – SPECIFIC CONDUCTANCE CONCENTRATION (umhos/cm))

(ND) – NON DETECT

– WELL SCREEN

– WATER LEVEL MEASURED IN SG–SERIES WELL ON JANUARY 28, 1993. THE WATER LEVEL INDICATED FOR THE NORTH BRANCH OF THE KALAMAZOO RIVER WAS ALSO MEASURED ON JANUARY 28, 1993 AT THE WEST STAFF GUAGE LOCATED NEAR MONITORING WELLS MW11SG & MW13SG.

0 100 200 400

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 10

CONCENTR
LVP061093

FIGURE 50

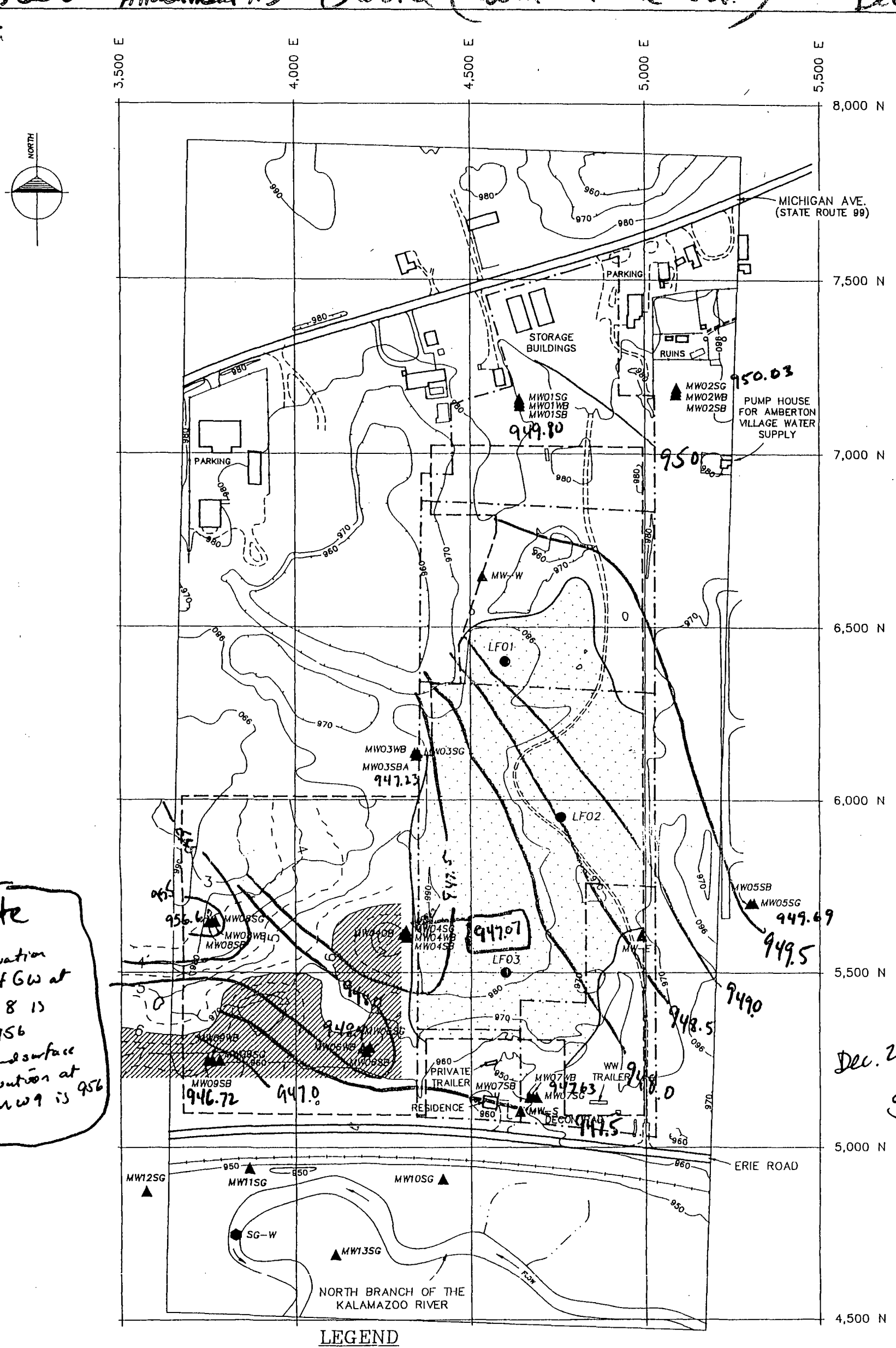
PROFILE OF SPECIFIC SPECIFIC CONDUCTANCE – ROUND 2 (umhos/cm)

ALBION–SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

JUNE, 1993 — 04011.03

WW Engineering & Science

SWL Attachment #3 Glacial (water table wells) Dec 22, 92



Note

Elevation of GW at MW 8 is 956

Ground surface elevation at MW 9 is 956

DRAFT

Dec. 22. 1992 glacial Statics

947.07

Stat: Water level at MW 04 in the well screened just below the water table.

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- PROPERTY BOUNDARY
- 970 — TOPOGRAPHIC CONTOUR (10ft. interval)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- ▲ MONITORING WELL LOCATION
- ● LEACHATE WELL LOCATION
- ⬢ STAFF GUAGE LOCATION
- LIMITS OF AREA SURVEYED WITH EM-34
- CONTOURED EM34 CONDUCTIVITY
- DEEP EM VALUES EXCEEDING 6 mmhos/m

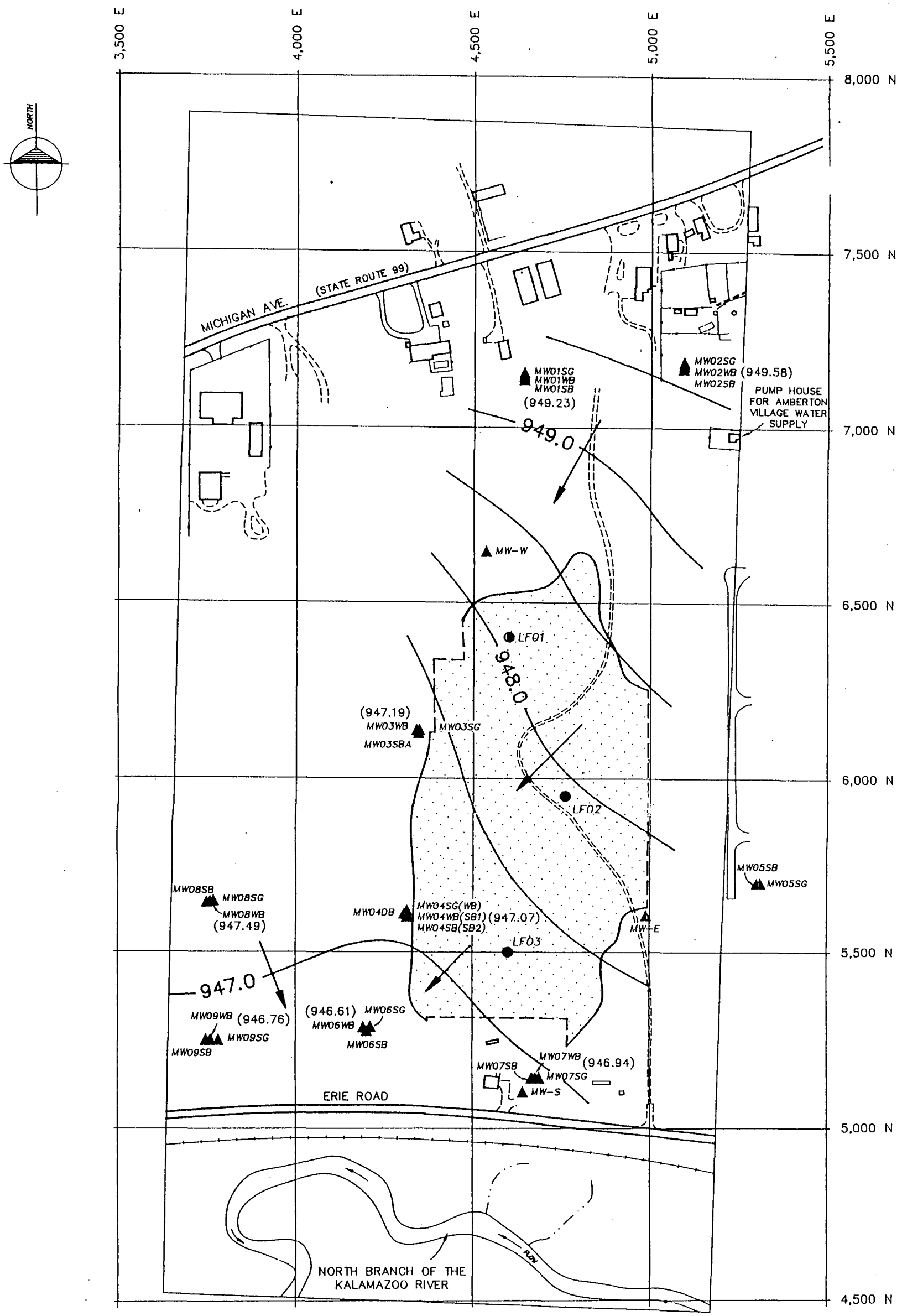
0 100 300 600

SCALE IN FEET

20M-H
LVP060493

FIGURE 14A
CONTOUR MAP OF EM34 QUADRATURE PHASE CONDUCTIVITY DATA (20M HORIZONTAL)
ALBION-SHERIDAN TOWNSHIP LANDFILL
JUNE, 1993 ALBION, MICHIGAN 04011.03

WW Engineering & Science



LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- 948.0 — GROUND WATER CONTOUR
- (947.19) — GROUND WATER ELEVATION
- DIRECTION OF GROUND WATER FLOW

WATER LEVELS WERE MEASURED IN WB-SERIES WELLS ON DECEMBER 22, 1992.

0 100 300 600

SCALE IN FEET

WBED-DEC
LVP042293

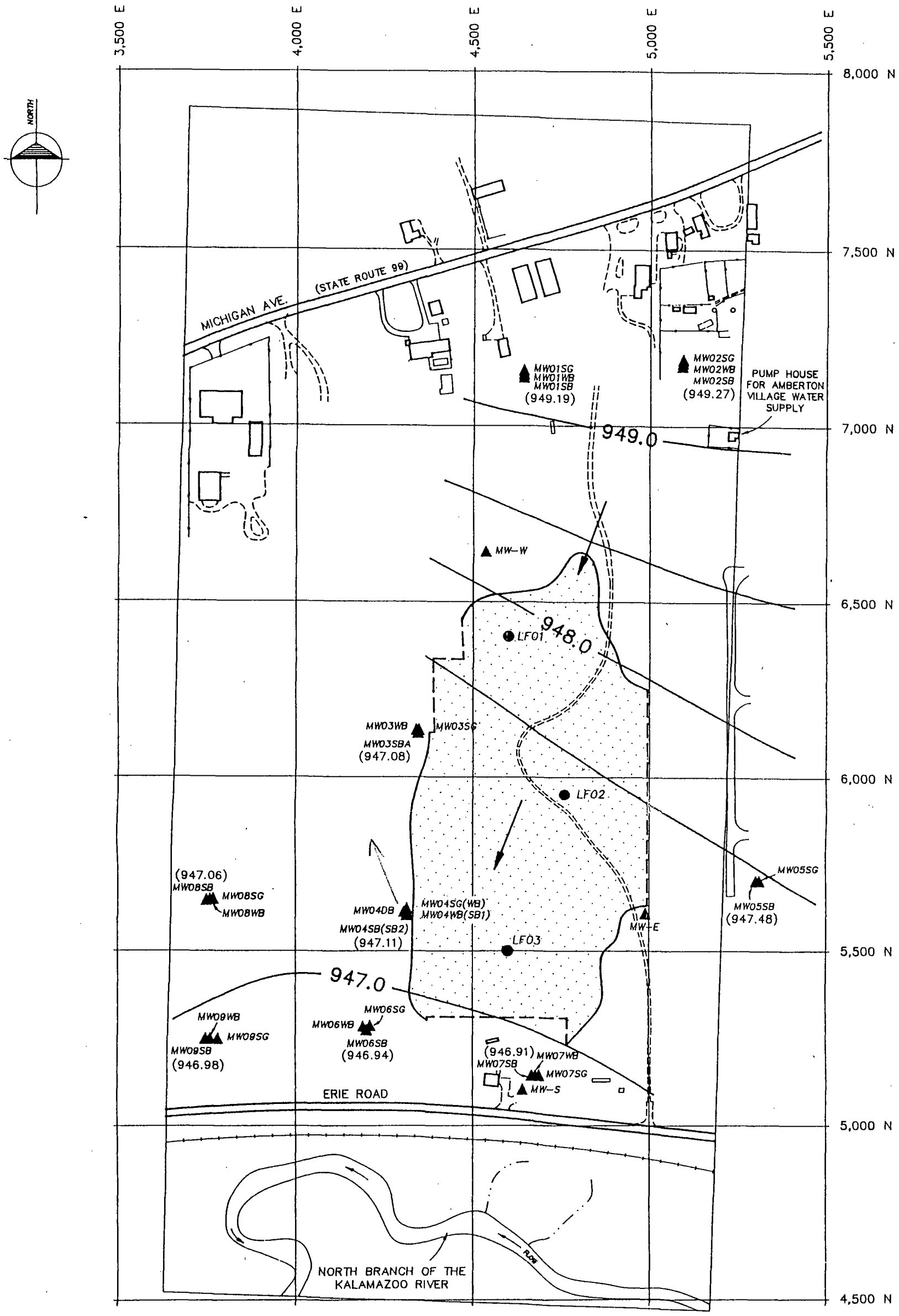
FIGURE 41

WEATHERED BEDROCK GROUND WATER FLOW MAP (DECEMBER 22, 1992)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

APRIL, 1993

04011.03



LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- 948.0 — GROUND WATER CONTOUR
- (947.06) — GROUND WATER ELEVATION
- DIRECTION OF GROUND WATER FLOW

WATER LEVELS WERE MEASURED IN SB-SERIES WELLS ON DECEMBER 22, 1992.

0 100 300 600

SCALE IN FEET

SBED-DEC
LVP042293

FIGURE 44

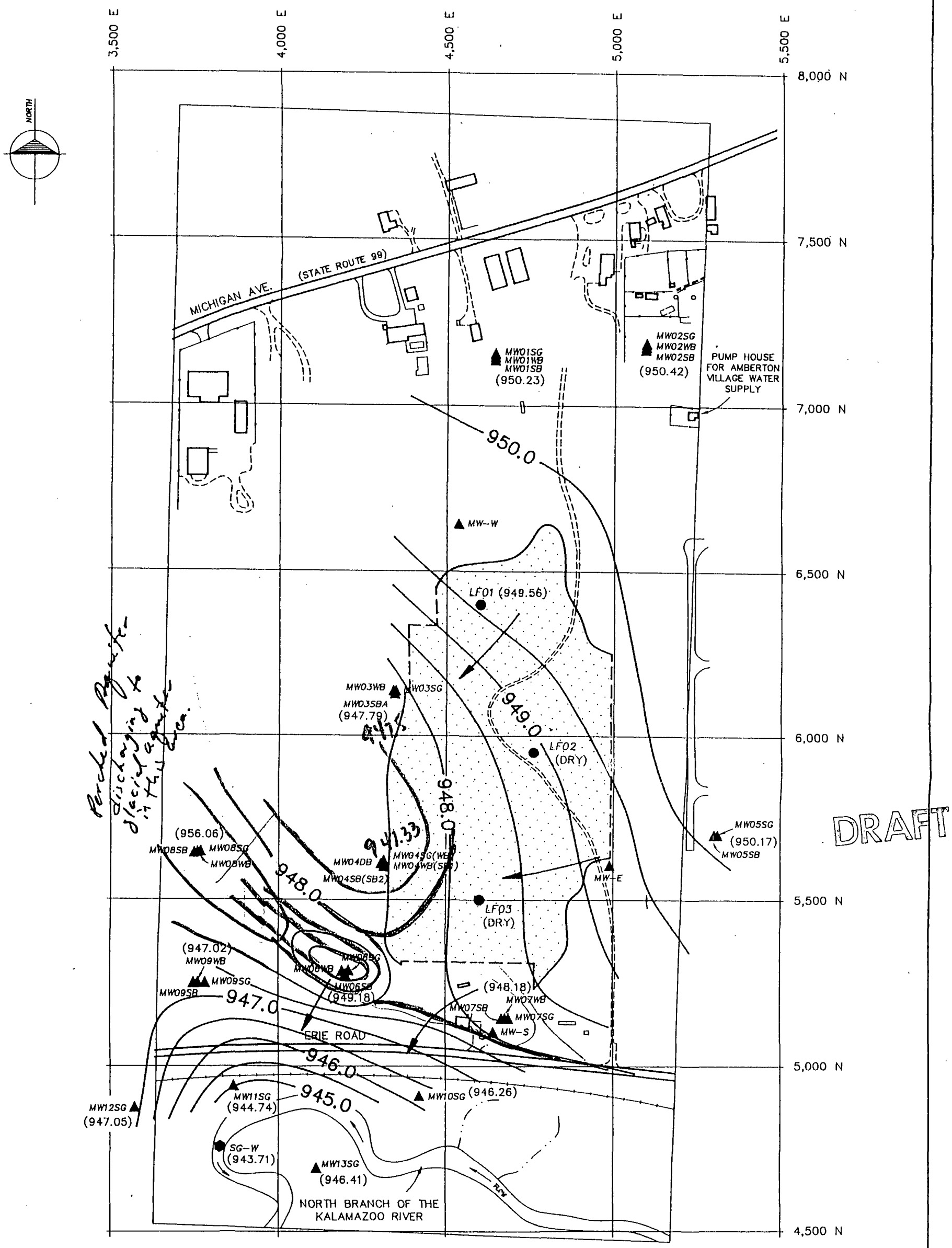
SHALLOW BEDROCK GROUND WATER FLOW MAP (DECEMBER 22, 1992)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

APRIL, 1993

04011.03

SWL Cladel Jan. '93



Perched Aquifer discharging to glacial aquifer via wetland

DRAFT

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- ▲ MONITORING WELL LOCATION
- ● LEACHATE WELL LOCATION
- ⬢ STAFF GAUGE LOCATION
- 948.0 — GROUND WATER CONTOUR
- (947.79) GROUND WATER ELEVATION
- DIRECTION OF GROUND WATER FLOW

WATER LEVELS WERE MEASURED IN SG-SERIES WELLS ON JANUARY 28, 1993.

0 100 300 600

SCALE IN FEET

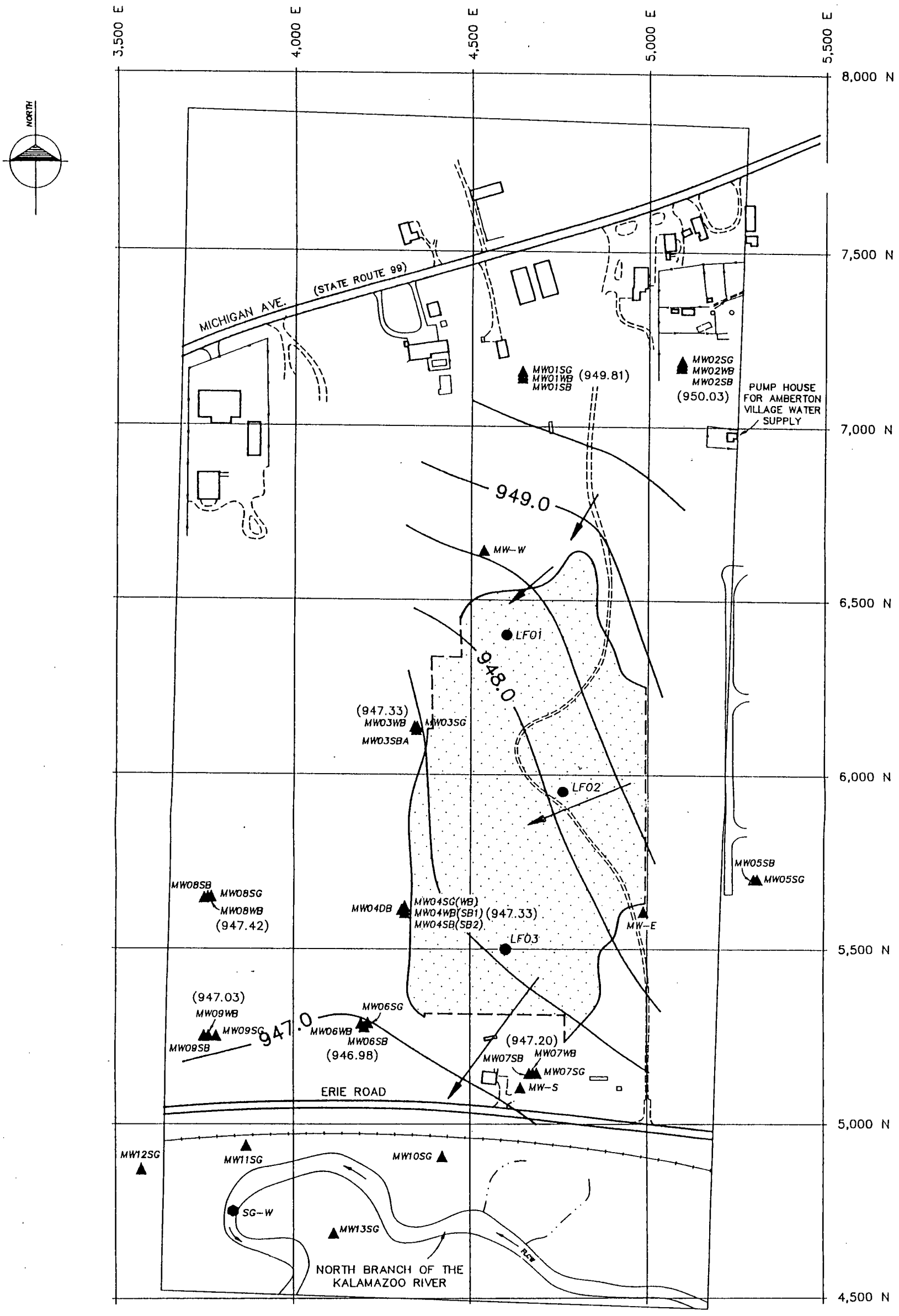
UGW-JAN
LVP042093

FIGURE 39

UNCONSOLIDATED GROUND WATER FLOW MAP (JANUARY 28, 1993)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

APRIL, 1993 04011.03



LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- STAFF GUAGE LOCATION
- 948.0 — GROUND WATER CONTOUR
- (947.33) — GROUND WATER ELEVATION
- DIRECTION OF GROUND WATER FLOW

WATER LEVELS WERE MEASURED IN WB-SERIES WELLS ON JANUARY 28, 1993

0 100 300 600

SCALE IN FEET

WBED-JAN
LVP042293

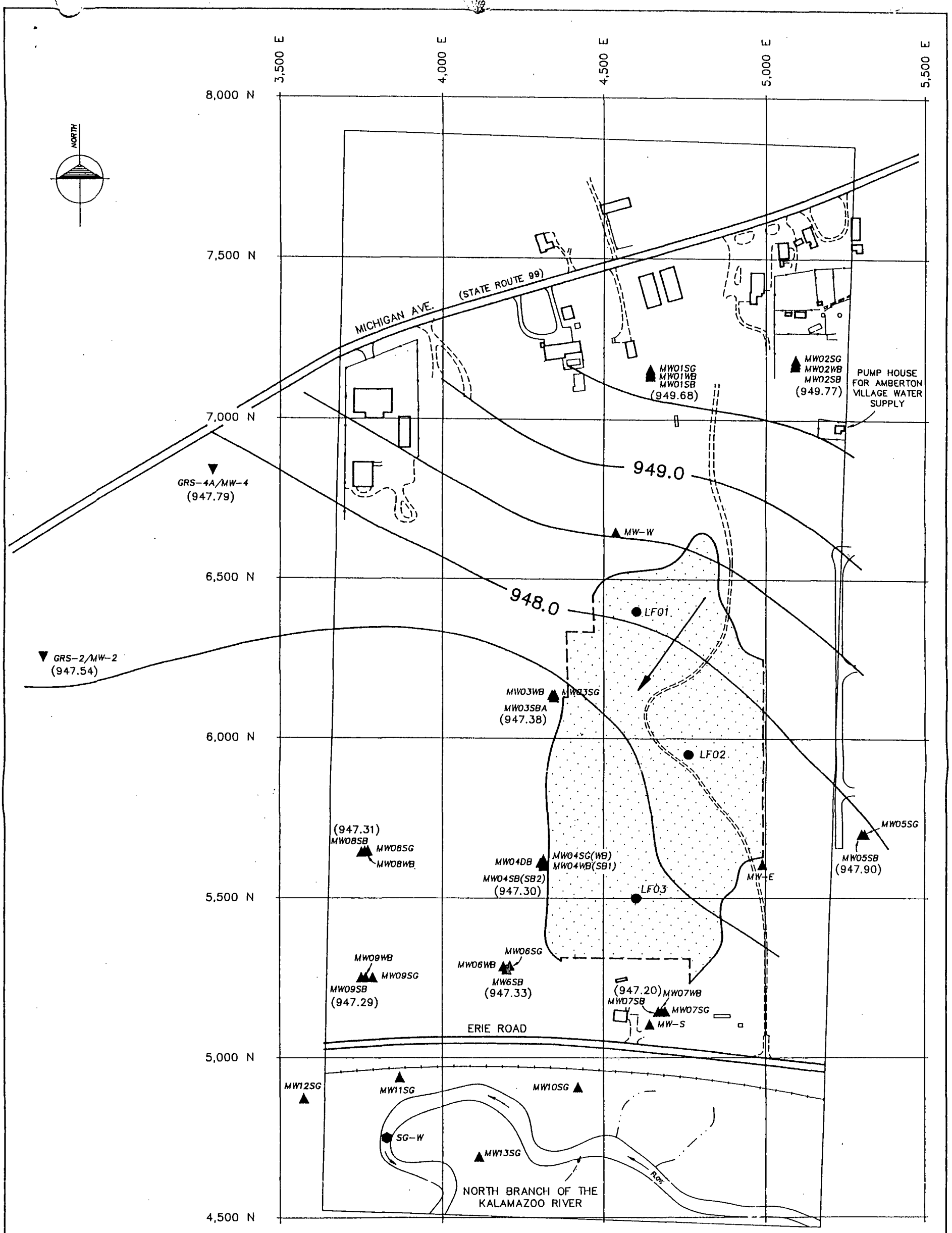
FIGURE 42

WEATHERED BEDROCK GROUND WATER FLOW MAP (JANUARY 28, 1993)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

APRIL, 1993

04011.03



LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- GRS WELL LOCATION
- STAFF GUAGE LOCATION
- 948.0 — GROUND WATER CONTOUR
- (947.27) — GROUND WATER ELEVATION
- DIRECTION OF GROUND WATER FLOW

WATER LEVELS WERE MEASURED IN SB-SERIES WELLS ON JANUARY 28, 1993.

0 100 300 600

SCALE IN FEET

SBED-JAN
LVP052093

FIGURE 45

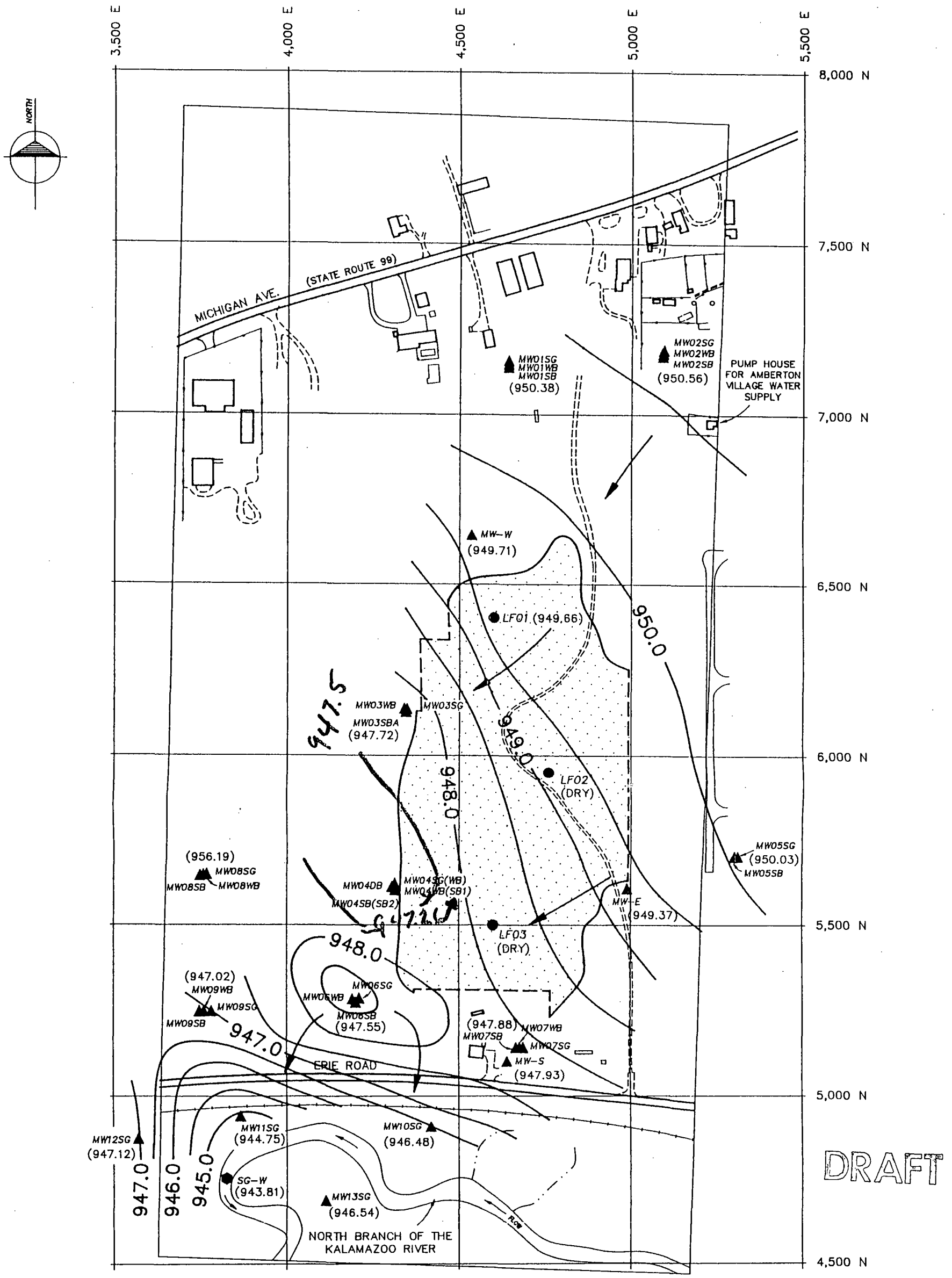
SHALLOW BEDROCK GROUND WATER FLOW MAP (JANUARY 28, 1993)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

MAY, 1993

04011.03

SW2 Glacial March 93



LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- LEACHATE WELL LOCATION
- 948.0 — GROUND WATER CONTOUR
- (947.72) — GROUND WATER ELEVATION
- DIRECTION OF GROUND WATER FLOW

WATER LEVELS WERE MEASURED IN SG-SERIES WELLS ON MARCH 8, 1993.

0 100 300 600

SCALE IN FEET

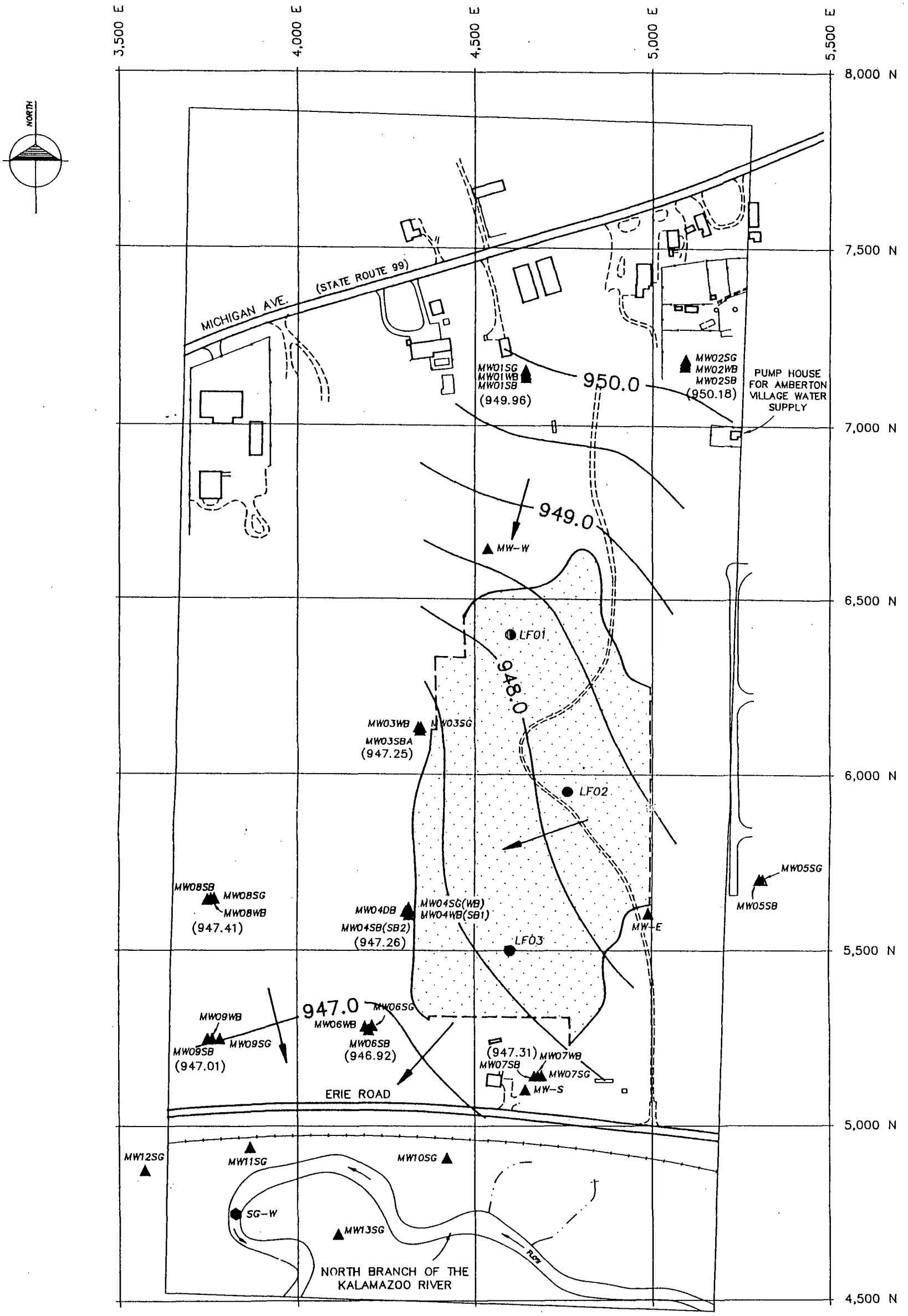
UGW-MAR
LVP042093

FIGURE 40

UNCONSOLIDATED GROUND WATER FLOW MAP (MARCH 8, 1993)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

APRIL 1993 04011.03



LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- ▲ MONITORING WELL LOCATION
- ● LEACHATE WELL LOCATION
- ⬢ STAFF GUAGE LOCATION
- 948.0 — GROUND WATER CONTOUR
- (947.26) GROUND WATER ELEVATION
- DIRECTION OF GROUND WATER FLOW

WATER LEVELS WERE MEASURED IN WB-SERIES WELLS ON MARCH 8, 1993.

0 100 300 600

SCALE IN FEET

WBED-MAR
LVP042293

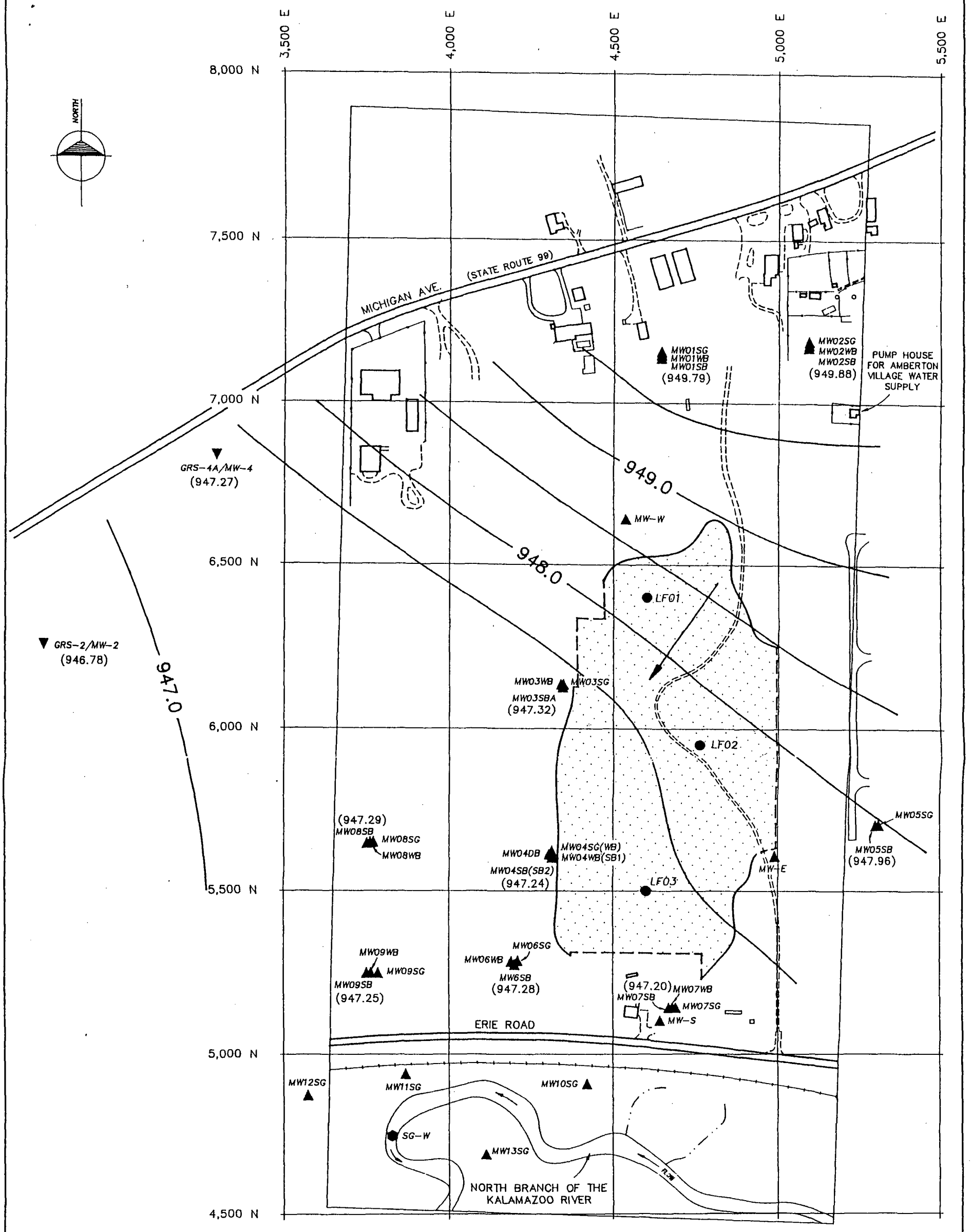
FIGURE 43

WEATHERED BEDROCK GROUND WATER FLOW MAP (MARCH 8, 1993)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

APRIL, 1993

04011.03



LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- GRS WELL LOCATION
- STAFF GUAGE LOCATION
- 948.0 — GROUND WATER CONTOUR
- (947.27) — GROUND WATER ELEVATION
- DIRECTION OF GROUND WATER FLOW

WATER LEVELS WERE MEASURED IN SB-SERIES WELLS ON MARCH 8, 1993.

0 100 300 600

SCALE IN FEET

SBED-MAR
LVP042293

FIGURE 46

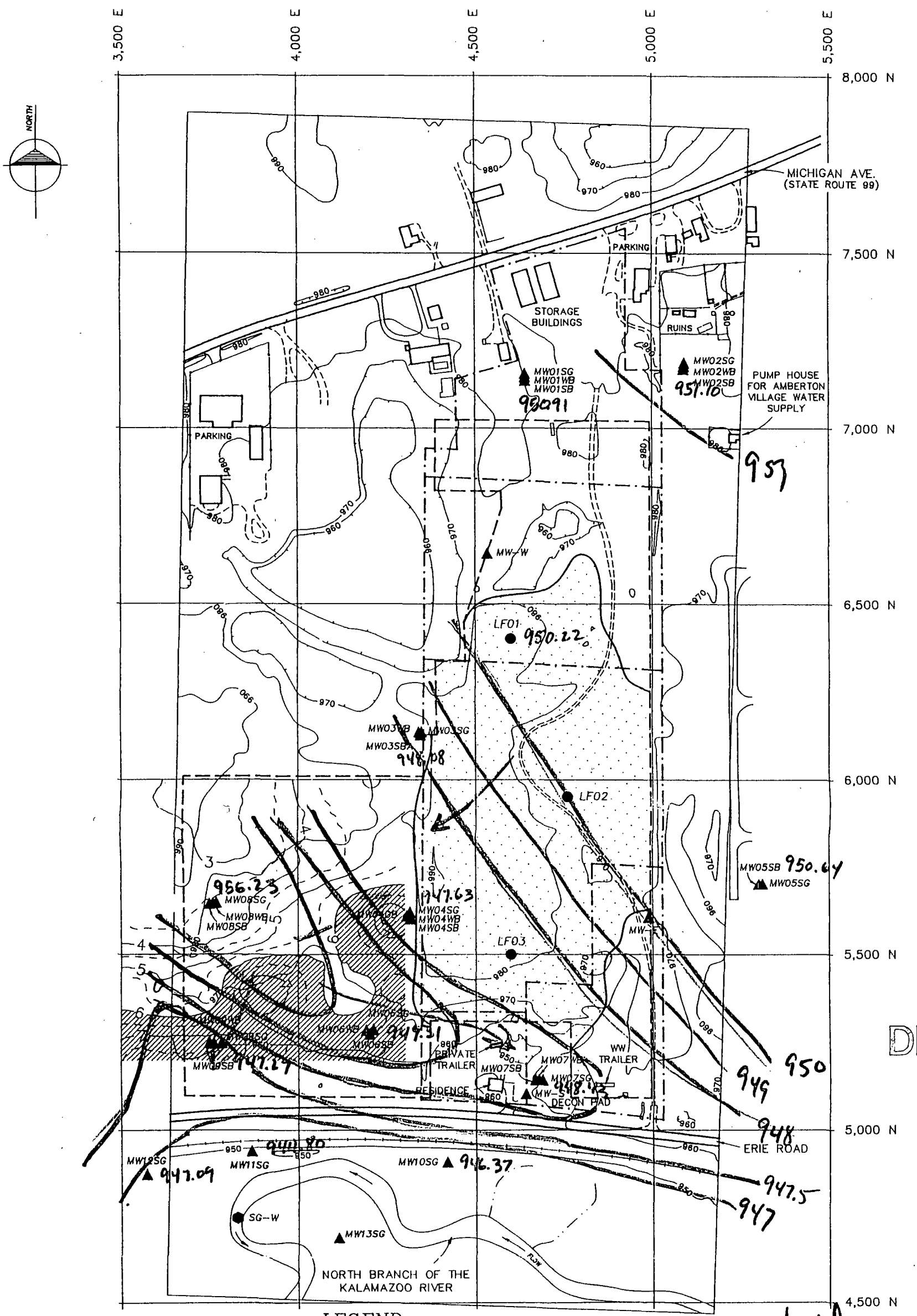
SHALLOW BEDROCK GROUND WATER FLOW MAP (MARCH 8, 1993)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

APRIL, 1993

04011.03

SWL Glacial April '93



DRAFT

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- PROPERTY BOUNDARY
- 970 — TOPOGRAPHIC CONTOUR (10ft. interval)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- ▲ MONITORING WELL LOCATION
- ● LEACHATE WELL LOCATION
- ⬢ STAFF GUAGE LOCATION
- LIMITS OF AREA SURVEYED WITH EM-34
- CONTOURED EM34 CONDUCTIVITY
- DEEP EM VALUES EXCEEDING 6 mmhos/m

Glacial
April 28, 1993

0 100 300 600

SCALE IN FEET

20M-H
LVP060493

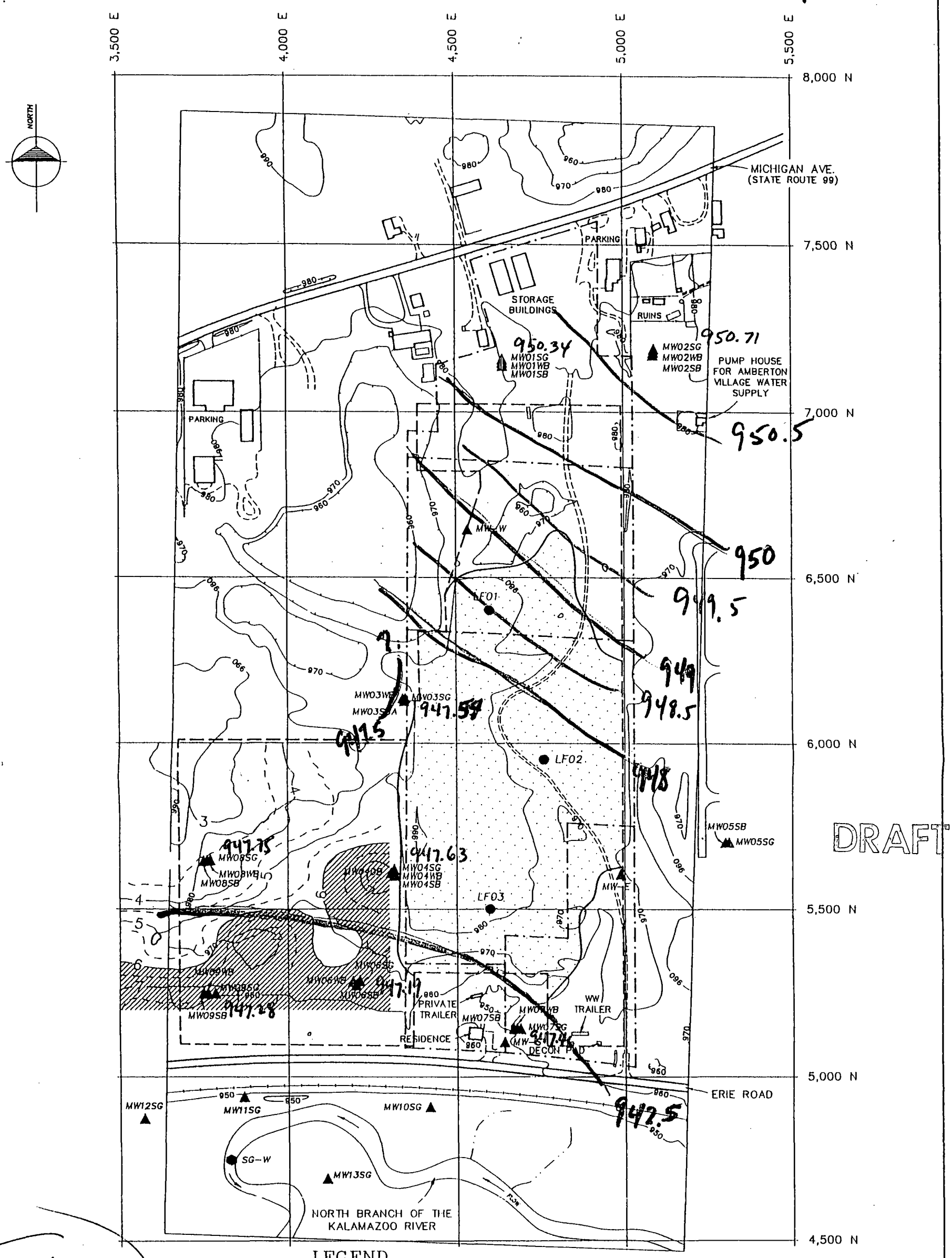
FIGURE 14A
CONTOUR MAP OF EM34 QUADRATURE PHASE CONDUCTIVITY DATA (20M HORIZONTAL)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

JUNE, 1993 04011.03

WW Engineering & Science

SWL Weathered Bedrock April



April
weathered
Bed Rock.

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- PROPERTY BOUNDARY
- 970 — TOPOGRAPHIC CONTOUR (10ft. Interval)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- ▲ MONITORING WELL LOCATION
- ● LEACHATE WELL LOCATION
- ⬢ STAFF GUAGE LOCATION
- LIMITS OF AREA SURVEYED WITH EM-34
- CONTOURED EM34 CONDUCTIVITY
- DEEP EM VALUES EXCEEDING 6 mmhos/m

0 100 300 600

SCALE IN FEET

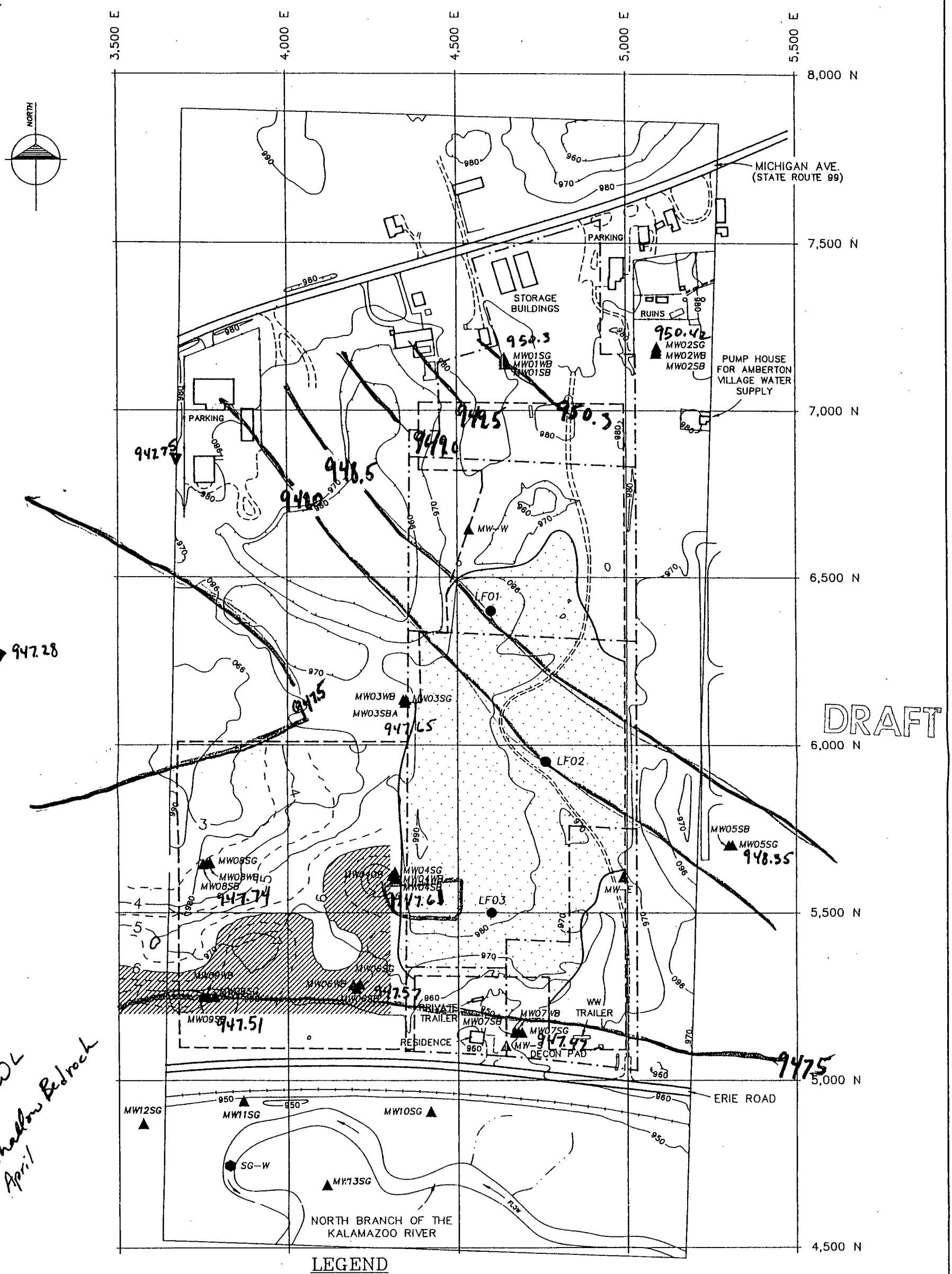
20M-H
LVP060493

DRAFT

FIGURE 14A
CONTOUR MAP OF EM34 QUADRATURE PHASE CONDUCTIVITY DATA (20M HORIZONTAL)
ALBION-SHERIDAN TOWNSHIP LANDFILL
JUNE, 1993 ALBION, MICHIGAN 04011.03

WW Engineering & Science

SWL Shallow Bedrock April



DRAFT

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- PROPERTY BOUNDARY
- 970 — TOPOGRAPHIC CONTOUR (10ft. Interval)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- STAFF GUAGE LOCATION
- LIMITS OF AREA SURVEYED WITH EM-34
- CONTOURED EM34 CONDUCTIVITY
- DEEP EM VALUES EXCEEDING 6 mmhos/m

0 100 300 600

SCALE IN FEET

20M-H
LVP060493

FIGURE 14A

CONTOUR MAP OF EM34 QUADRATURE PHASE CONDUCTIVITY DATA (20M HORIZONTAL)

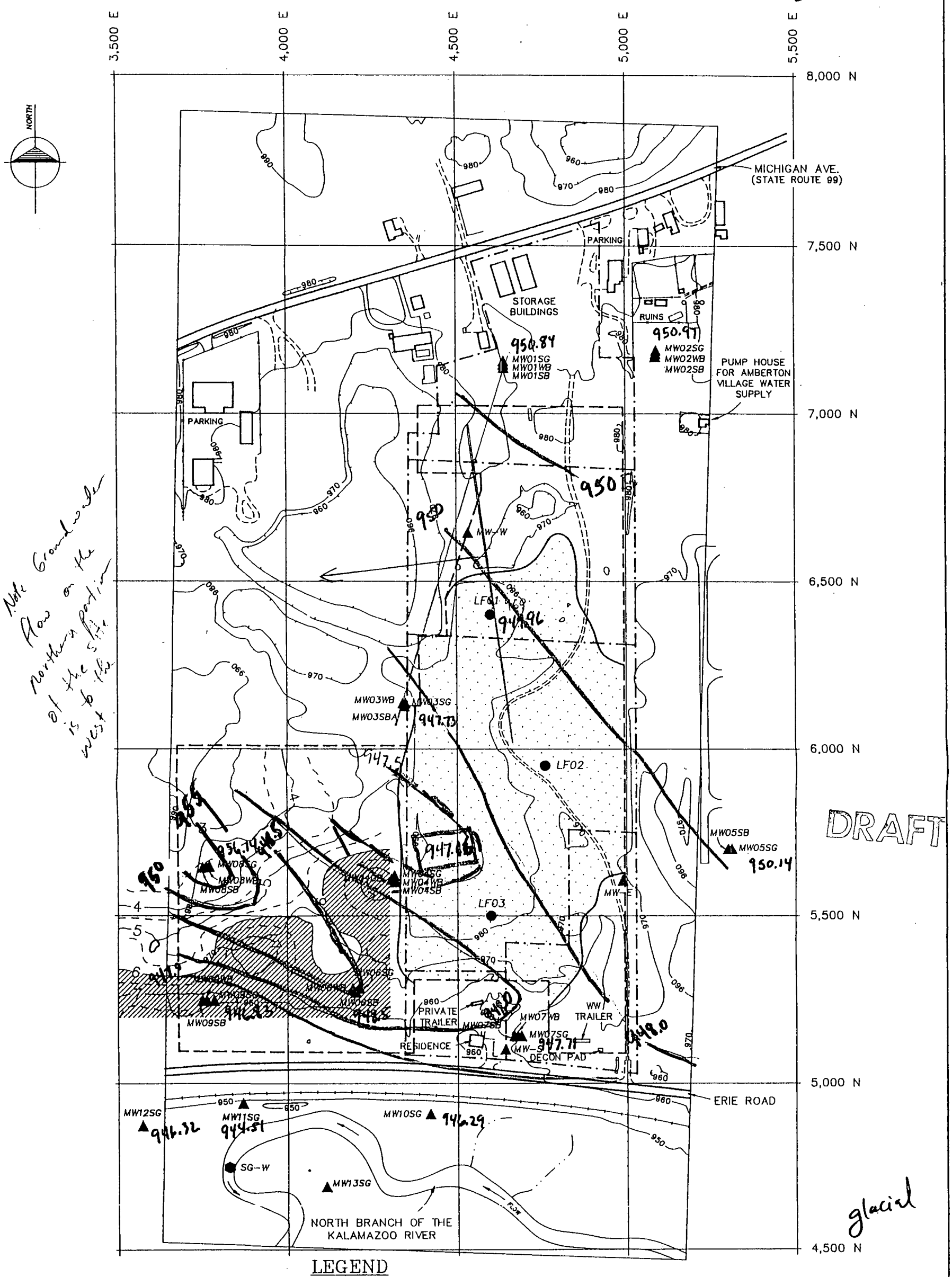
ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

JUNE, 1993 04011.03

SWL Shallow Bedrock April

WW Engineering & Science

SWL Glacial August 93



Note Groundwater flow on the northern portion of the site is to the west

DRAFT

glacial

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- PROPERTY BOUNDARY
- 970 — TOPOGRAPHIC CONTOUR (10ft. interval)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- ▲ MONITORING WELL LOCATION
- ● LEACHATE WELL LOCATION
- ⬢ STAFF GUAGE LOCATION
- LIMITS OF AREA SURVEYED WITH EM-34
- CONTOURED EM34 CONDUCTIVITY
- DEEP EM VALUES EXCEEDING 6 mmhos/m

August 10, 1993

only month where MW 7 was lower than 3. usual it is app. .3 to .4 foot lower.

0 100 300 600
SCALE IN FEET

20M-H
LVP060493

FIGURE 14A
CONTOUR MAP OF EM34 QUADRATURE PHASE CONDUCTIVITY DATA (20M HORIZONTAL)
ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN
JUNE, 1993 04011.03

WW Engineering & Science

SWL

Weathered Bed Rock

Aug '93

3,500 E | 4,000 E | 4,500 E | 5,000 E | 5,500 E

8,000 N | 7,500 N | 7,000 N | 6,500 N | 6,000 N | 5,500 N | 5,000 N | 4,500 N

NORTH

MICHIGAN AVE. (STATE ROUTE 99)

950.10
MW01SG
MW01WB
MW01SB
(949.79)

MW02SG 950.53
MW02WB
MW02SB
(949.88)

PUMP HOUSE FOR AMBERTON VILLAGE WATER SUPPLY

950

950.5

949.5

949

948.5

948

948.0

947.0

GRS-4A/MW-4
(947.27)

GRS-2/MW-2
(946.78)

MW-W

LF01

LF02

LF03

MW-E

MW03WB
MW03SG
MW03SBA
(947.32) 947.16

(947.29)
MW08SB
MW08SG
MW08WB
947.41

MW04DB
MW04SG(WB)
MW04WB(SB1)
MW04SB(SB2)
(947.24) 947.10

MW05SG
MW05SB
(947.96)

MW09WB
MW09SG
MW09SB
(947.25) 946.85

MW06SG
MW06WB
MW6SB
(947.28) 946.80

(947.20)
MW07WB
MW07SB
MW07SG
MW-S 947.83

ERIE ROAD

947.5

947.0

MW12SG

MW11SG

MW10SG

SG-W

MW13SG

NORTH BRANCH OF THE KALAMAZOO RIVER

ROW

DRAFT

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- GRS WELL LOCATION
- STAFF GUAGE LOCATION
- 948.0 — GROUND WATER CONTOUR
- (947.27) GROUND WATER ELEVATION
- DIRECTION OF GROUND WATER FLOW

WATER LEVELS WERE MEASURED IN SB-SERIES WELLS ON MARCH 8, 1993.

0 100 300 600
SCALE IN FEET

SBED-MAR
LVP042293

FIGURE 46

~~SHALLOW BEDROCK~~

GROUND WATER FLOW MAP
(MARCH 8, 1993)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

APRIL, 1993

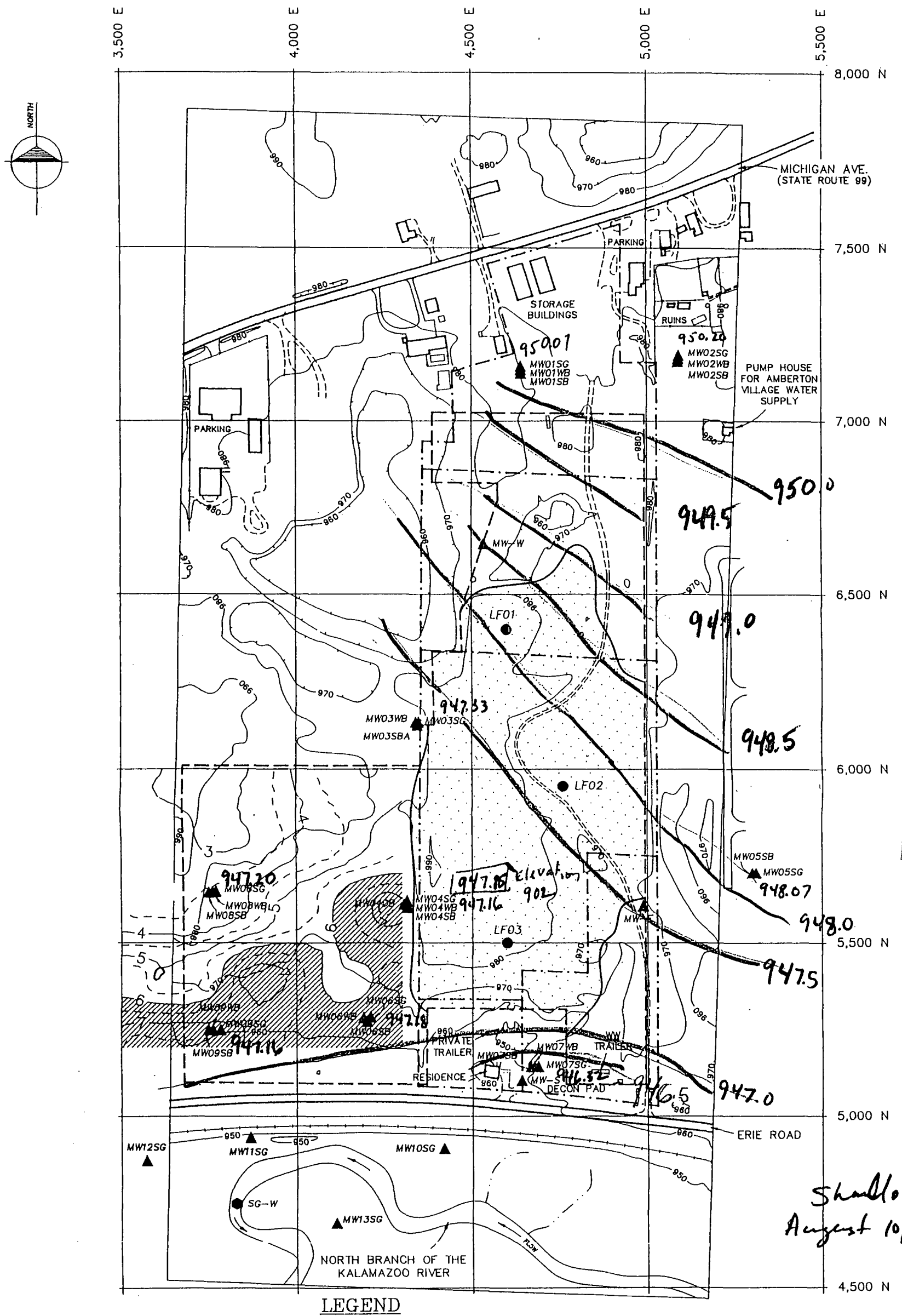
04011.03

WW Engineering & Science

SWL

Shallow Bed Rock

Aug '93



DRAFT

Shallow Bedrock.
August 10, 1993

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- PROPERTY BOUNDARY
- 970 – TOPOGRAPHIC CONTOUR (10ft. Interval)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- STAFF GUAGE LOCATION
- LIMITS OF AREA SURVEYED WITH EM-34
- CONTOURED EM34 CONDUCTIVITY
- DEEP EM VALUES EXCEEDING 6 mmhos/m

0 100 300 600

SCALE IN FEET

20M-H
LVP060493

FIGURE 14A

CONTOUR MAP OF EM34 QUADRATURE PHASE CONDUCTIVITY DATA (20M HORIZONTAL)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

JUNE, 1993

04011.03

WW Engineering & Science

SWL Glacial Sept 93

3,500 E | 4,000 E | 4,500 E | 5,000 E | 5,500 E

8,000 N | 7,500 N | 7,000 N | 6,500 N | 6,000 N | 5,500 N | 5,000 N | 4,500 N

NORTH

MICHIGAN AVE. (STATE ROUTE 99)

PARKING

STORAGE BUILDINGS

RUINS

PUMP HOUSE FOR AMBERTON VILLAGE WATER SUPPLY

PARKING

PRIVATE TRAILER

RESIDENCE

WW TRAILER

DECON PAD

ERIE ROAD

NORTH BRANCH OF THE KALAMAZOO RIVER

MW01SG 950.78
MW01WB
MW01SB

MW02SG 950.89
MW02WB
MW02SB

MW03WB
MW03SG 947.8
MW03SBA

MW04WB
MW04SG
MW04SB

MW05SB
MW05SG 950.14

MW06WB
MW06SG
MW06SB

MW07WB
MW07SB
MW07SG

MW08WB
MW08SB
MW08SG

MW09SB 947.13

MW10SG 946.3

MW11SG 944.72

MW12SG 947.05

MW13SG

MW-W

MW-S 947.91

LF01 949.99

LF02

LF03

SG-W

950.5 950 949.5 949 948.5 948 947.5 947

Sept SWL Shallow Glacial

3 point problem between wells MW15G, MW13G + LF01 show flow-down-flow to the west of the site

DRAFT

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- PROPERTY BOUNDARY
- 970 – TOPOGRAPHIC CONTOUR (10ft. Interval)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- STAFF GUAGE LOCATION
- LIMITS OF AREA SURVEYED WITH EM-34
- CONTOURED EM34 CONDUCTIVITY
- DEEP EM VALUES EXCEEDING 6 mmhos/m

0 100 300 800

SCALE IN FEET

20M-H
LVP060493

FIGURE 14A
CONTOUR MAP OF EM34 QUADRATURE PHASE CONDUCTIVITY DATA (20M HORIZONTAL)
ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN
JUNE, 1993 04011.03

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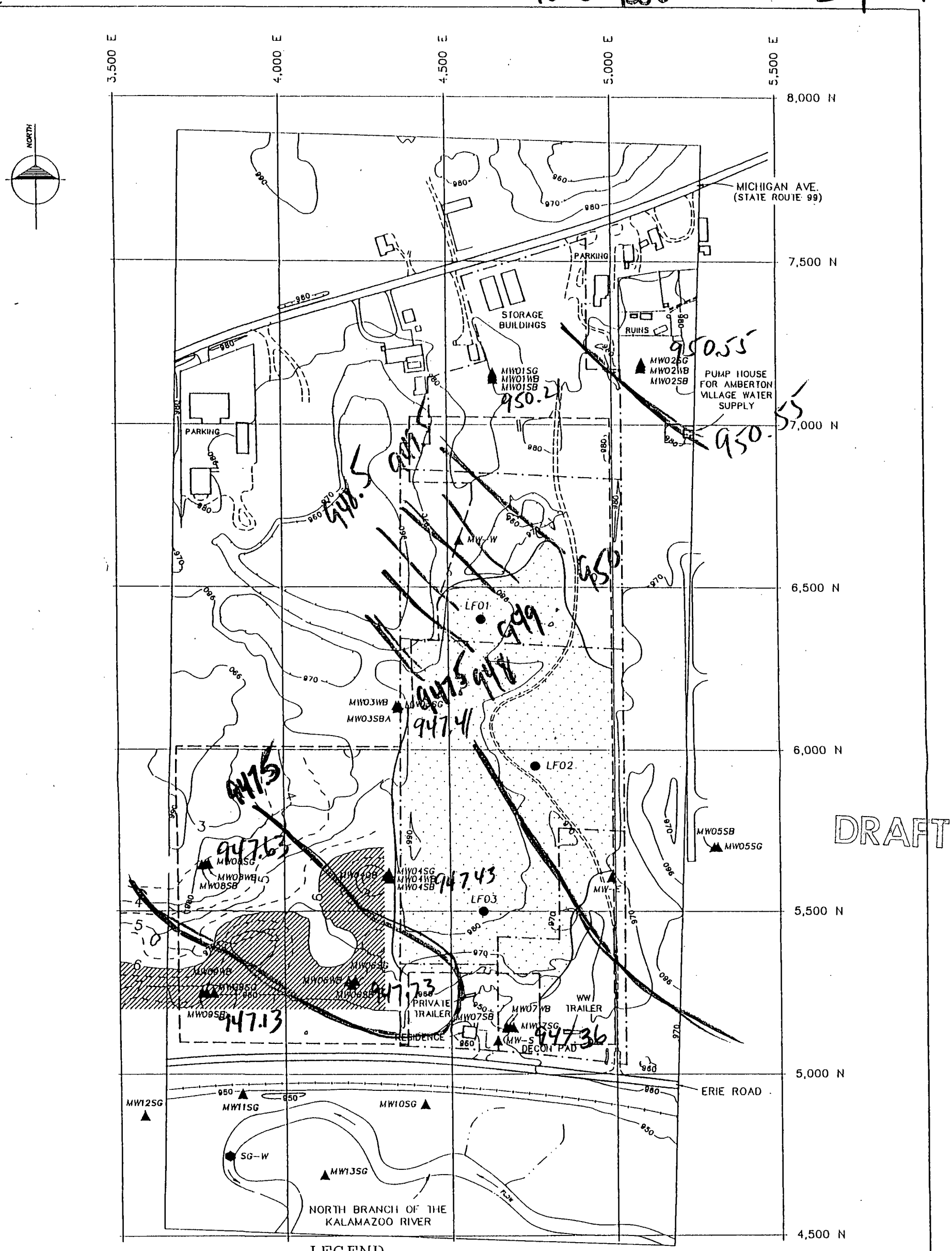
SWL Weathered Bed Rock Sept '93



DRAFT

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- PROPERTY BOUNDARY
- 970 — TOPOGRAPHIC CONTOUR (10ft. Interval)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- ▲ MONITORING WELL LOCATION
- ● LEACHATE WELL LOCATION
- ⬢ STAFF GUAGE LOCATION
- LIMITS OF AREA SURVEYED WITH EM-34
- CONTOURED EM34 CONDUCTIVITY
- DEEP EM VALUES EXCEEDING 6 mmhos/m

0 100 300 600

SCALE IN FEET

20M-H
LVP060493

FIGURE 14A
CONTOUR MAP OF EM34 QUADRATURE PHASE CONDUCTIVITY DATA (20M HORIZONTAL)
ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN
JUNE, 1993
04011.03

SWL Shallow Bedrock Sept '93

Shallow Bedrock

3,500 E 4,000 E 4,500 E 5,000 E 5,500 E

8,000 N 7,500 N 7,000 N 6,500 N 6,000 N 5,500 N 5,000 N 4,500 N

NORTH

MICHIGAN AVE. (STATE ROUTE 99)

PARKING

STORAGE BUILDINGS

RUINS

PUMP HOUSE FOR AMBERTON VILLAGE WATER SUPPLY

950.24

950.16

MW01SG MW01WB MW01SB

MW02SG MW02WB MW02SB

MW03WB MW03SG MW03SBA 947.56

MW04SG MW04WB MW04SB 947.43

MW05SB MW05SG 948.20

MW06SG MW06WB MW06SB 947.63

MW07WB MW07SB MW07SG 947.35

MW08SG MW08WB MW08SB

MW09SG MW09WB MW09SB 947.44

947.47

MW10SG MW11SG MW12SG MW13SG

MW-W MW-S

LF01 LF02 LF03

PRIVATE TRAILER RESIDENCE

WW TRAILER

DECON PAD

ERIE ROAD

SG-W

NORTH BRANCH OF THE KALAMAZOO RIVER

947.5 948 948.5 949 950

DRAFT

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- PROPERTY BOUNDARY
- 970 — TOPOGRAPHIC CONTOUR (10ft. Interval)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- STAFF GUAGE LOCATION
- LIMITS OF AREA SURVEYED WITH EM-34
- CONTOURED EM34 CONDUCTIVITY
- DEEP EM VALUES EXCEEDING 6 mmhos/m

0 100 300 600

SCALE IN FEET

20M-H
LVP060493

FIGURE 14A
CONTOUR MAP OF EM34 QUADRATURE PHASE CONDUCTIVITY DATA (20M HORIZONTAL)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

JUNE, 1993 04011.03

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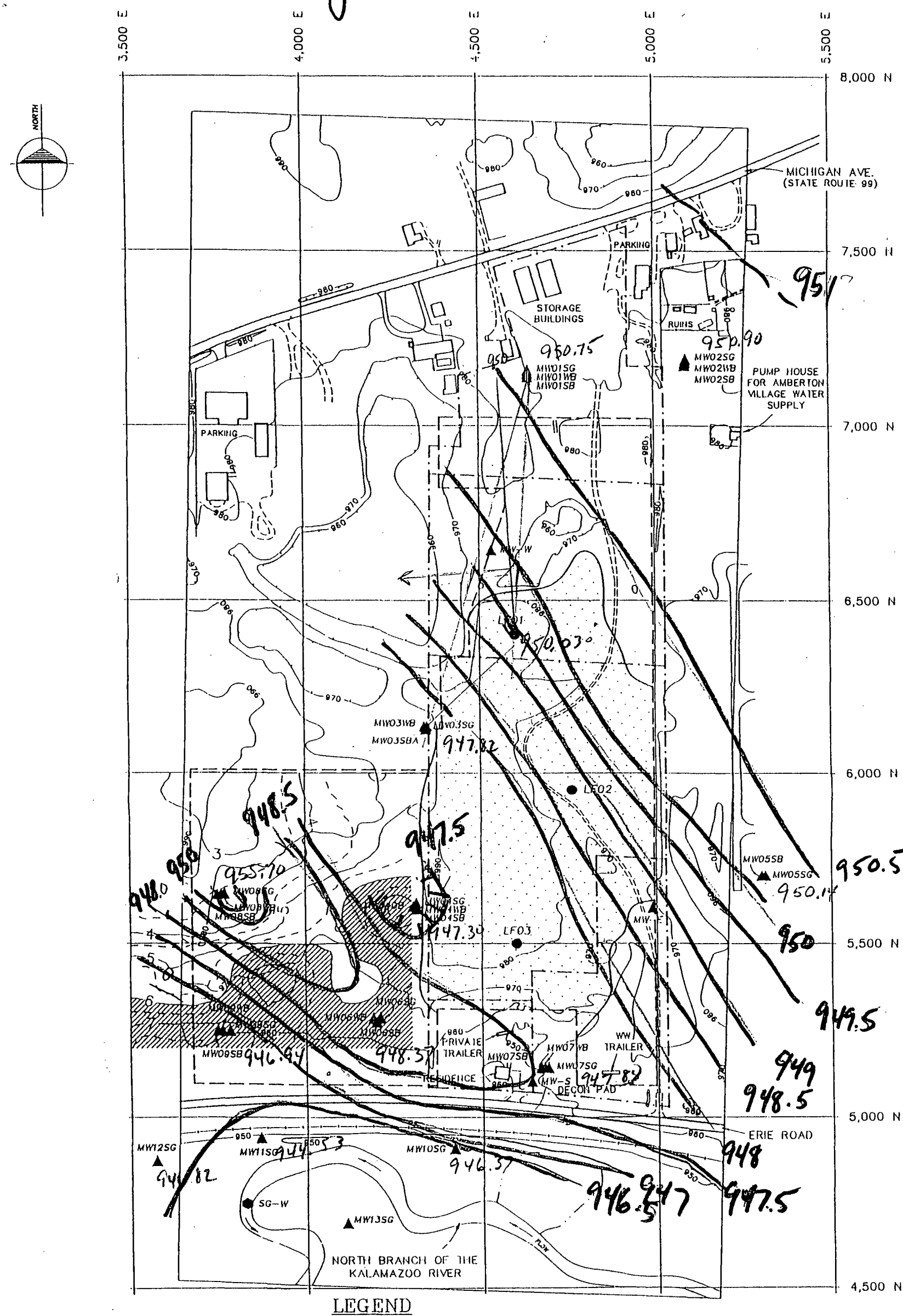
SWL glacial Nov. '93



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LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- PROPERTY BOUNDARY
- 970 — TOPOGRAPHIC CONTOUR (10ft. Interval)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- ▲ MONITORING WELL LOCATION
- ● LEACHATE WELL LOCATION
- ⬢ STAFF GUAGE LOCATION
- LIMITS OF AREA SURVEYED WITH EM-34
- CONTOURED EM34 CONDUCTIVITY
- DEEP EM VALUES EXCEEDING 6 mmhos/m

0 100 300 600

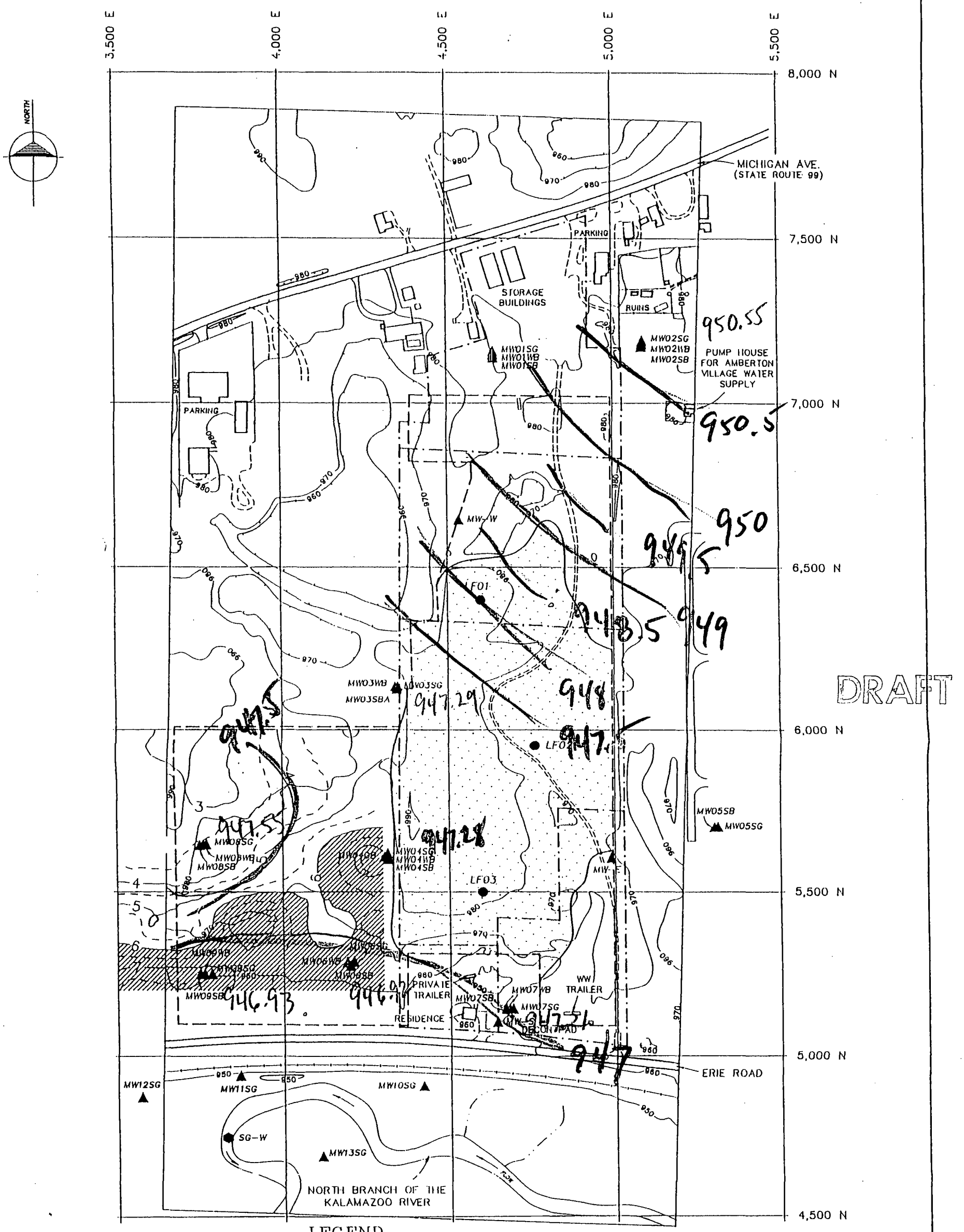
SCALE IN FEET

20M-11
LVP060493

FIGURE 14A
CONTOUR MAP OF EM34 QUADRATURE PHASE CONDUCTIVITY DATA (20M HORIZONTAL)
ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN
JUNE, 1993
04011.03

WW Engineering & Science

SWL Weathered Bed Rock Nov 1993



LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- PROPERTY BOUNDARY
- 970 — TOPOGRAPHIC CONTOUR (10ft. Interval)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- MONITORING WELL LOCATION
- LEACHATE WELL LOCATION
- STAFF GUAGE LOCATION
- LIMITS OF AREA SURVEYED WITH EM-34
- CONTOURED EM34 CONDUCTIVITY
- DEEP EM VALUES EXCEEDING 6 mmhos/m

0 100 300 600

SCALE IN FEET

20M-H
LVP060493

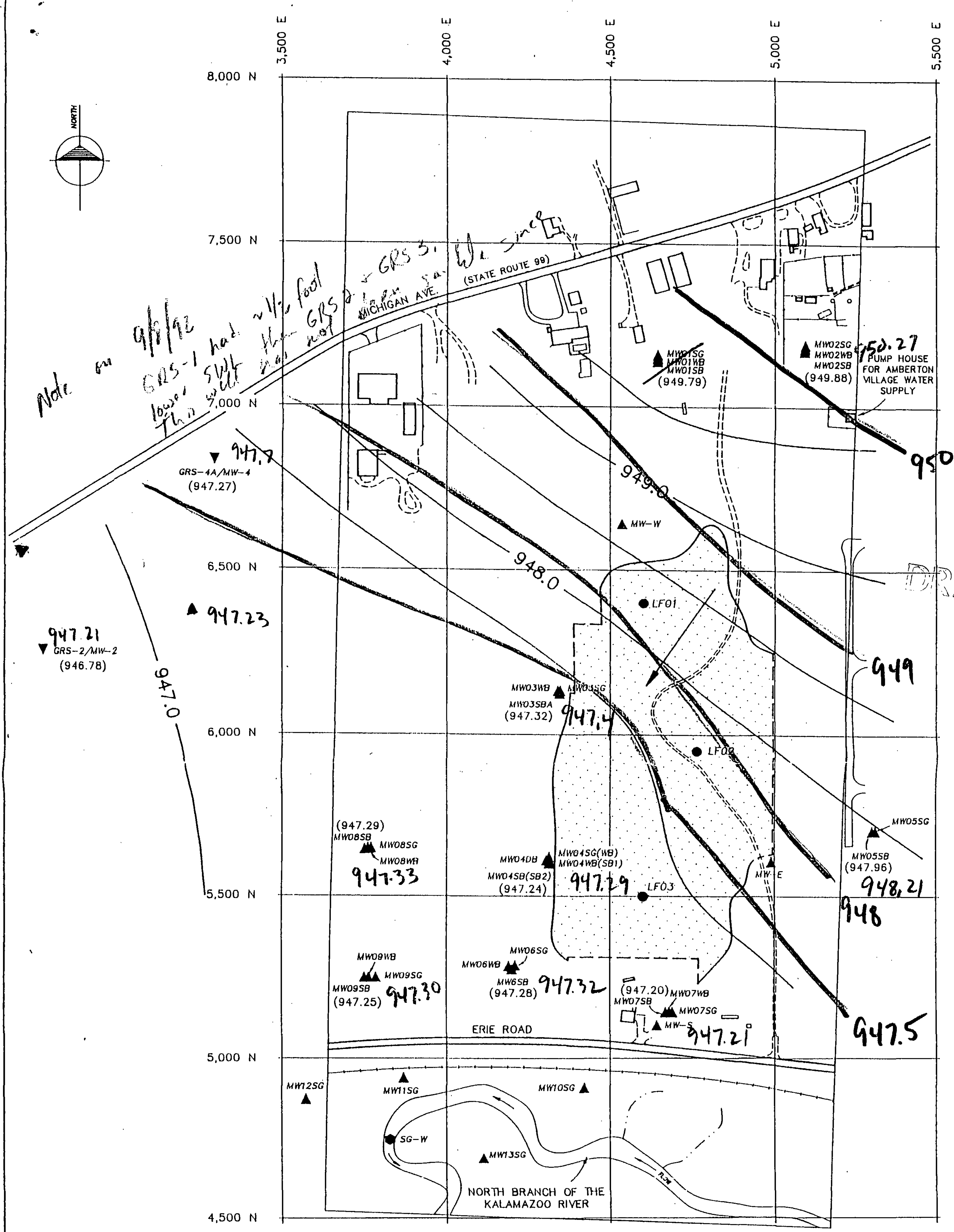
FIGURE 14A

CONTOUR MAP OF EM34 QUADRATURE PHASE CONDUCTIVITY DATA (20M HORIZONTAL)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

JUNE, 1993 04011.03

SWL Shallow bed rock Nov. 1993



NORTH
3,500 E
4,000 E
4,500 E
5,000 E
5,500 E
8,000 N
7,500 N
7,000 N
6,500 N
6,000 N
5,500 N
5,000 N
4,500 N
MICHIGAN AVE. (STATE ROUTE 99)
Note on 9/8/92 GRS-1 had ~1½ foot lower SWL than GRS 2 & GRS 3.
MW01SG
MW01WB
MW01SB
(949.79)
MW02SG
MW02WB
MW02SB
(949.88)
950.27
PUMP HOUSE FOR AMBERTON VILLAGE WATER SUPPLY
950
949.0
949
948.0
948
947.5
947.0
947.7
GRS-4A/MW-4
(947.27)
947.23
947.21
GRS-2/MW-2
(946.78)
MW-W
LF01
LF02
LF03
MW03WB
MW03SG
MW03SBA
(947.32)
947.4
MW05SG
MW05SB
(947.96)
948.21
MW-E
(947.29)
MW08SB
MW08SG
MW08WB
947.33
MW04DB
MW04SG(WB)
MW04WB(SB1)
MW04SB(SB2)
(947.24)
947.29
MW09WB
MW09SG
MW09SB
(947.25)
947.30
MW06SG
MW06WB
MW6SB
(947.28)
947.32
(947.20)
MW07WB
MW07SB
MW07SG
MW-S
947.21
ERIE ROAD
MW12SG
MW11SG
MW10SG
SG-W
MW13SG
NORTH BRANCH OF THE KALAMAZOO RIVER
FLOW
DRAFT

LEGEND

- APPROXIMATE LANDFILL BOUNDARY (DASHED PORTIONS INDICATE THE SURVEY GRID BOUNDARY)
- UNPAVED ROAD
- INTERMITTENT STREAM
- RAILROAD TRACK
- ▲ – MONITORING WELL LOCATION
- ● – LEACHATE WELL LOCATION
- ▼ – GRS WELL LOCATION
- ⬢ – STAFF GUAGE LOCATION
- 948.0 — – GROUND WATER CONTOUR
- (947.27) – GROUND WATER ELEVATION
- ← – DIRECTION OF GROUND WATER FLOW

WATER LEVELS WERE MEASURED IN SB-SERIES WELLS ON MARCH 8, 1993.

0 100 300 600

SCALE IN FEET

SBED-MAR
LVP042293

FIGURE 46

SHALLOW BEDROCK GROUND WATER FLOW MAP (MARCH 8, 1993)

ALBION-SHERIDAN TOWNSHIP LANDFILL
ALBION, MICHIGAN

APRIL, 1993 04011.03

WW Engineering & Science